CHAPTER 12

MISCELLANEOUS FACILITIES

Although many of the equipments discussed in this chapter operate on the radio, radar, or sonar principle, their application is so specialized that they are dealt with more appropriately as miscellaneous facilities, instead of as radio, radar, or sonar equipments. For this reason, they were not included in preceding equipment chapters.

RADIO DIRECTION FINDERS

The Radio Direction Finder (RFD) is installed aboard most ships for use in locating personnel afloat in liferafts or lifeboats equipped with radio transmitters. It also is used to obtain bearings on intercepted radio and radar signals of both known and unknown origin.

Essentially, the radio direction finder is a sensitive receiver connected to a directional antenna. Early models utilized a loop antenna that was rotated manually to the position of strongest signal reception. Bearing of the signal was read from an indicating device consisting of a pointer and an azimuth scale. Modern RDFs have antennas that are rotated at a constant speed by a motor. Bearing information is indicated on the face of a cathode-ray tube.

Range data cannot be obtained by taking a single bearing with an RDF. Usually, several bearings are taken either as rapidly as possible on several radio beacons or radio stations of known geographical location, or on a single beacon or station of known location, allowing from 10- to 30-minute intervals between bearings. Plotting these bearings gives a fix that is more or less accurate, depending on the accuracy of the bearings.

Currently, three different models of radio direction finders are installed on ships in the active fleet. They are models AN/URD-2( ), AN/URD-4( ), and AN/SRD-7( ). A combination MF/HF radio direction finder, the AN/SRD-7( ), is installed mostly on submarines.

Shipboard installations of the AN/URD-4( ) direction finder set (fig. 12-1) consist of an antenna, a receiver/power supply unit, an azimuth indicator, and a signal data converter (not shown). The set provides visual (and sometimes aural) direction-finding information from radio signals in the frequency range of 225.0 to 399.9 MHz. For surface to surface operation, the range of the equipment is approximately 20 miles; for surface to air, approximately 90 to 125 miles. Bearing accuracy is plus or minus 5°.

Tuning controls for the receiver are located on the front panel of the azimuth indicator. By setting the digit selector switches to the desired frequency, the receiver can be tuned to any one of 1750 frequencies, spaced 0.1 MHz apart. To facilitate rapid tuning, any 20 of the 1750 available frequencies may be preset on the digit selector switches. Then, the preset frequencies are selected by means of a single channel selector switch. For convenience in servicing the equipment, or for emergency operation, digit selector switches also are provided on the front panel of the receivers.

Visual information appears on the face of a cathode-ray tube in the azimuth indicator. Around the perimeter of the scope is a compass scale from which is read the signal bearing. When no signal is present, the pattern on the scope is a circle. When a signal is present, this circle is resolved into a propeller-shaped pattern whose axis lies along a line indicating the signal source direction and a point 180° displaced from the direction of signal origin. To eliminate this ambiguity, it is necessary to cause a further change in the shape of the pattern. Placing the calibrate-sense switch in its sense position causes the propeller-shaped pattern to become a V-shaped pattern, the apex of which indicates the signal bearing.

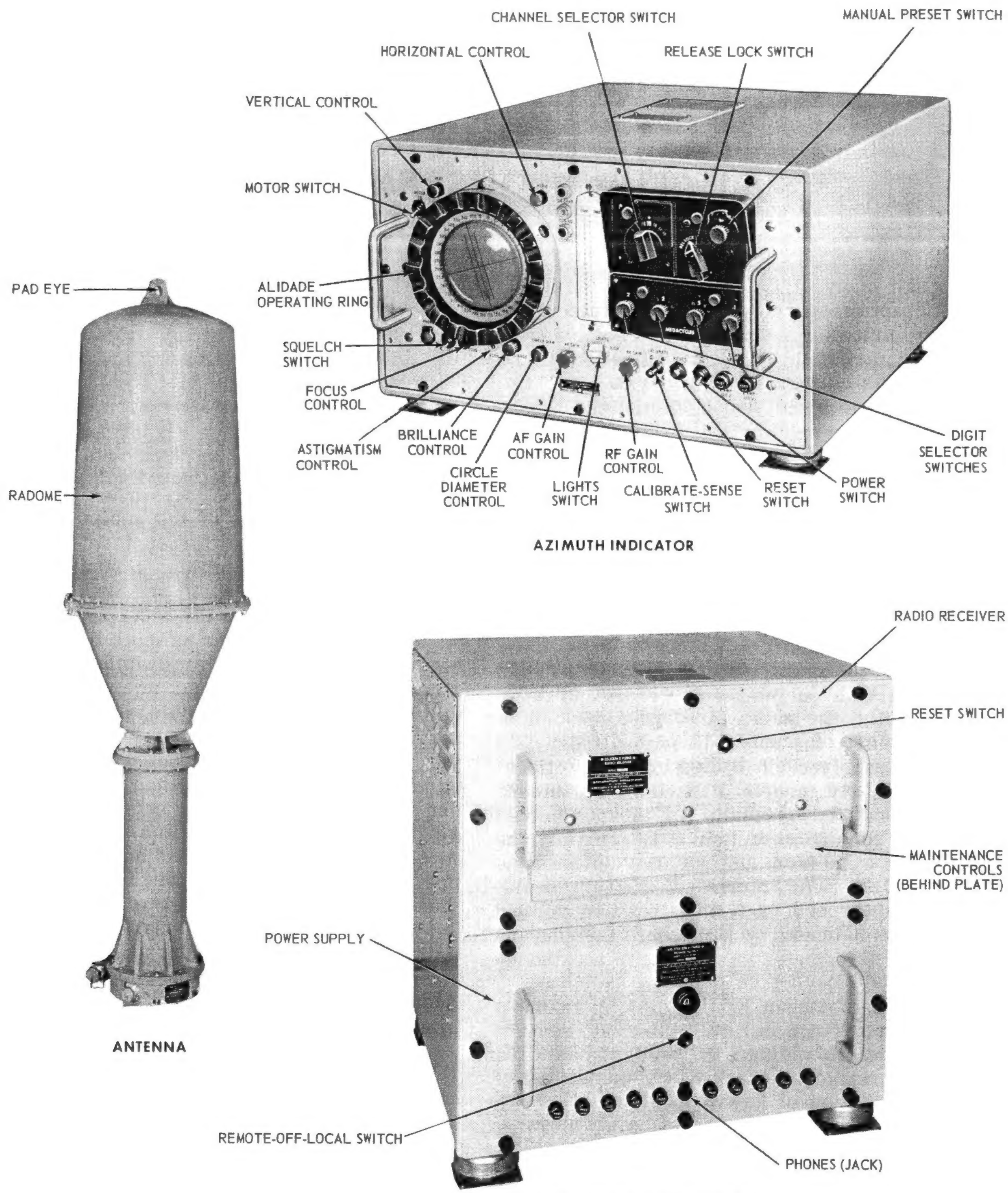

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Figure 12-1.—Radio Direction Finder Set AN/URD-4( ) major components.

The direction finder set is designed for either shipboard or shore use. When the equipment is installed on ships, the bow of the ship is used as reference or zero degree direction. Signal bearings, consequently, are relative to the ship's heading if not corrected by the action of the signal data converter. A switch, on the front panel of the azimuth indicator permits selection of either a relative bearing or a true geographical bearing of a received signal.

CLOSED-CIRCUIT TELEVISION

On larger ships closed-circuit television systems are becoming commonplace. They make it possible for shipboard personnel at remote locations to view or monitor various operations, and to exchange vital information rapidly. Although present applications of TV are limited to interior communications, it is envisioned that future applications will include intership conferences and briefings.

One closed-circuit TV system installed aboard ship is the AN/SXQ-2 (fig. 12-2). This system consists of a camera, a system control unit, an electronic equipment cabinet, and one or more viewer units. It is used principally for viewing the data displayed on the CIC plotting board at remote locations.

When the system is used to transfer tactical information from the CIC to remote stations,

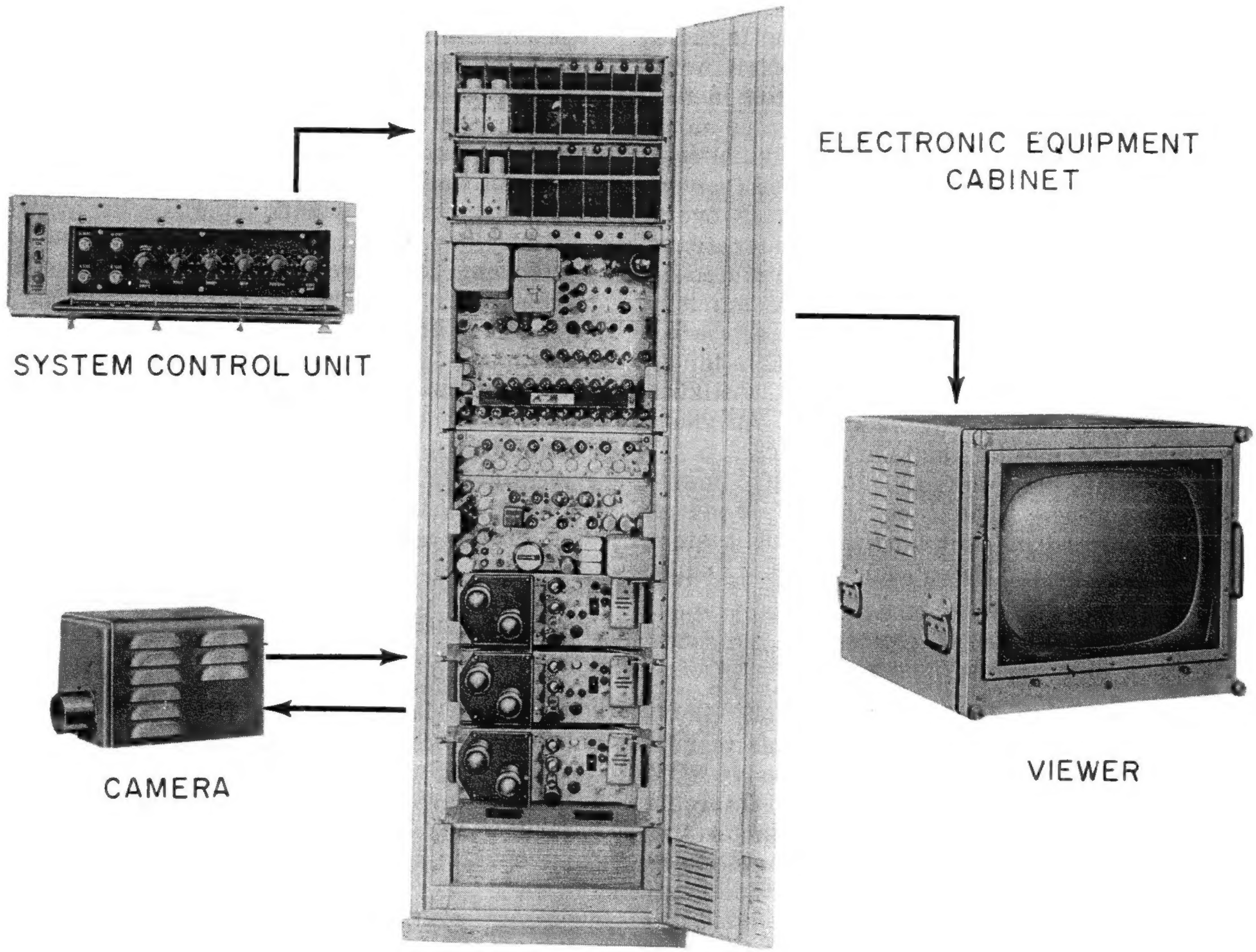

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Figure 12-2.—Television System AN/SXQ-2.

the TV camera is fastened to the overhead in the CIC so that it overlooks the plotting board. The video output of the camera is sent to a maximum of eight viewer units. From these video signals, the viewer units reproduce and display the data appearing on the plotting board. Thus, cognizant personnel are informed instantaneously and accurately of any changes in a tactical situation.

The AN/SXQ-2 system also is used aboard aircraft carriers for briefing pilots before a mission. When the system is used for this purpose, a viewer unit is installed in each readyroom. The TV camera is arranged so that it picks up the briefing officer and any pertinent charts or displays. With this arrangement, all pilots concerned are briefed in one session.

Most aircraft carriers now have a closed-circuit television system that aids the landing signal officers (LSO) in landing the aircraft. In general, the system operates in the following manner. A television camera mounted in the centerline of the flight deck spots the plane at the beginning of its landing approach, and follows it to the touchdown. A second TV camera on the carrier's superstructure then takes over. Viewer units installed at strategic locations reproduce the images picked up by the cameras. Crosshairs on the viewer screens and minute-by-minute records of time, air speed, wind velocity, and flight number on dials at the top of the screens are utilized by the LSO in talking the pilot down to a safe landing. All video and audio information, including the conversations between the pilot and the LSO, is recorded on tape. The tape thus becomes a complete record of each landing. This system is referred to as the PLAT (Pilot Landing Aid Television) system.

ELECTRONIC COUNTERMEASURES

Electronic countermeasures (ECM) may be classified as active or passive. Passive ECM is the use of receiving equipment to intercept enemy radar or radio transmissions. Active ECM is the application of transmitting equipment that may be used for jamming the enemy transmissions.

In order to use countermeasures most effectively against an enemy radar, as many as possible of the following characteristics should be known about the enemy radar facility: (1) the frequency, pulse width, pulse repetition frequency, and peak power of the transmissions; (2) the receiver bandwidth and the time constants of the receiver coupling circuits; (3) anti-jamming features; (4) amount of shielding; (5) type of indicator; (6) antenna beamwidth; (7) types of scan; and (8) use of the radar.

To use countermeasures most effectively against enemy communications systems, the following information is needed: (1) frequency of transmission, (2) type of modulation, and (3) receiver bandwidth.

Some of the foregoing information is obtained by analyzing the enemy transmission. Other data may be obtained by examining captured equipment.

Special equipment has been developed for use in analyzing RF transmissions. This equipment includes search receivers, which search the various frequency bands for the various types of emissions; panoramic adapters, which measure the frequency, strength, and type of modulation of a transmission in a selected band of frequencies; and pulse analyzers, which measure the pulse rate and width. The pulse analyzer and the panoramic adapter are used with the search receiver.

Antijamming measures or counter-countermeasures (CCM) are used to reduce the effect of enemy jamming on our own equipment. Some of the most important CCM devices in receivers are special filters that pass only the most important parts of signals, thus rejecting as much of the jamming signal as possible. In the transmitters, a great many radar equipments have tunable magnetrons whose frequency may be varied at intervals to prevent enemy jamming transmitters from locking on the radar signal.

Several ECM equipments (or systems) are in use today. Among these equipments are the models AN/SLA-1 and -2 series, AN/SLR-2, AN/SLR-10, AN/WLR-1, AN/WLR-3, AN/ULQ-5, and AN/ULQ-6. Because of the security AN/SLR-10, AN/WLR-1, AN/WLR-3, AN/ULQ-tailed description cannot be given in this text. Further information concerning ECM and ECCM equipments may be obtained from the training manuals for the Radarman rating, or from the appropriate equipment technical manuals.

UNDERWATER TELEPHONE

The AN/UQC-1( ) sonar set, popularly known as the underwater telephone, provides CW and

voice communications between surface vessels and submarines. Although its application differs, the set operates on the same principle as other sonar equipments.

The set consists of a transmitter, receiver, power supply, transducer, and remote control unit. All controls needed to operate the set are contained in the remote control unit (fig. 12-3).

To transmit by voice, a toggle switch on the front panel of the remote control unit is set to VOICE & CW RECEIVE, the microphone button is depressed and the message is spoken into the microphone. For CW transmission, the toggle switch is set to CW TRANSMIT, and the handkey is used to send the message. During either type of transmission, an output indicator on the control unit flashes each time energy is transmitted.

The range of the transmission varies with water conditions and the relative noise output of the ship. Under good conditions, communications between ships is possible at ranges up to 12,000 yards and in some instances far beyond this range. On board submarines, the range may be extended over that obtained by surface ships by the phenomenon of channeling, that is, keeping the transmission between sharp temperature gradients within the layer in which it was transmitted. If this layer extends for many miles, the range of the signal also is extended for many miles.

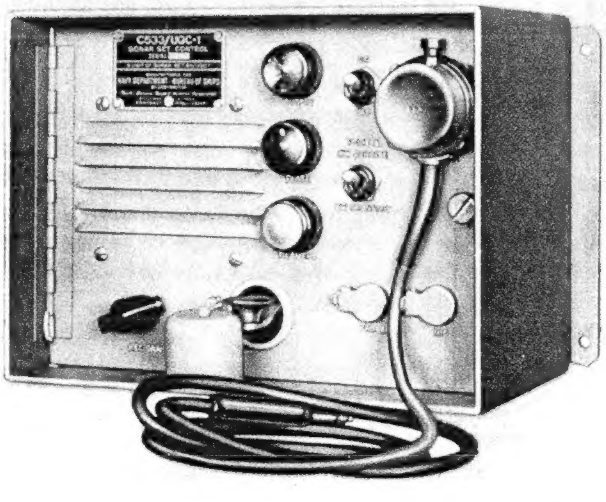

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Figure 12-3.—Remote Control Unit for AN/UQC-1( ).

COMMUNICATION CONSOLE

To centralize the control of voice communication circuits at key tactical stations, some large types of ships utilize communication console equipments such as the AN/SIC-2 (fig. 12-4). A system may conprise 1 or 2 master consoles, 16 subconsoles, 4 radio-control/terminal-unit assemblies, and 1 or 2 power supplies. The quantities of the various components may be varied to meet the requirements of the vessel on which the equipment is installed.

Each master console provides pushbutton selection of a combination of 1 to 16 radiotelephone curcuits (channels or frequencies) for both transmitting and receiving.

Selector switches and volume controls mounted on the console provide facilities for the connection of amplifiers and overhead speakers to permit monitoring any 4 of 16 radiotelephone circuits.

A selector switch provides for the selection of any 1 of 16 radiotelephone circuits for quick relay playback as recorded by a short-memory voice recorder.

An interphone system provides two-way or network communications between master consoles and subconsoles. Sixteen interphone circuits may be selected at the master console.

At each master console, facilities are provided for communications with any combination (up to 10) of 20 ship's intercom stations. Intercom systems differ from the interphone in this manner: Interphones systems use radiotelephone handsets or headphones. Intercoms are microphone speaker systems that provide amplified voice communications between two or more stations. The intercoms are used chiefly during routine conditions when personnel are unavailable to man all the sound-powered telephone circuits. During general quarters (CONDITION ONE) and general quarters relaxed (CONDITION ONE E), they should be used only for passing emergency information.

Each master console provides facilities for monitoring or two-way communications without crosstalk on any combination of 14 sound-powered telephone circuits. Provision also is made for crossing 7 sound-powered telephone circuits, and for monitoring or transmissing on the crossed circuits.

A microphone mounted on the master console is provided for connection to the

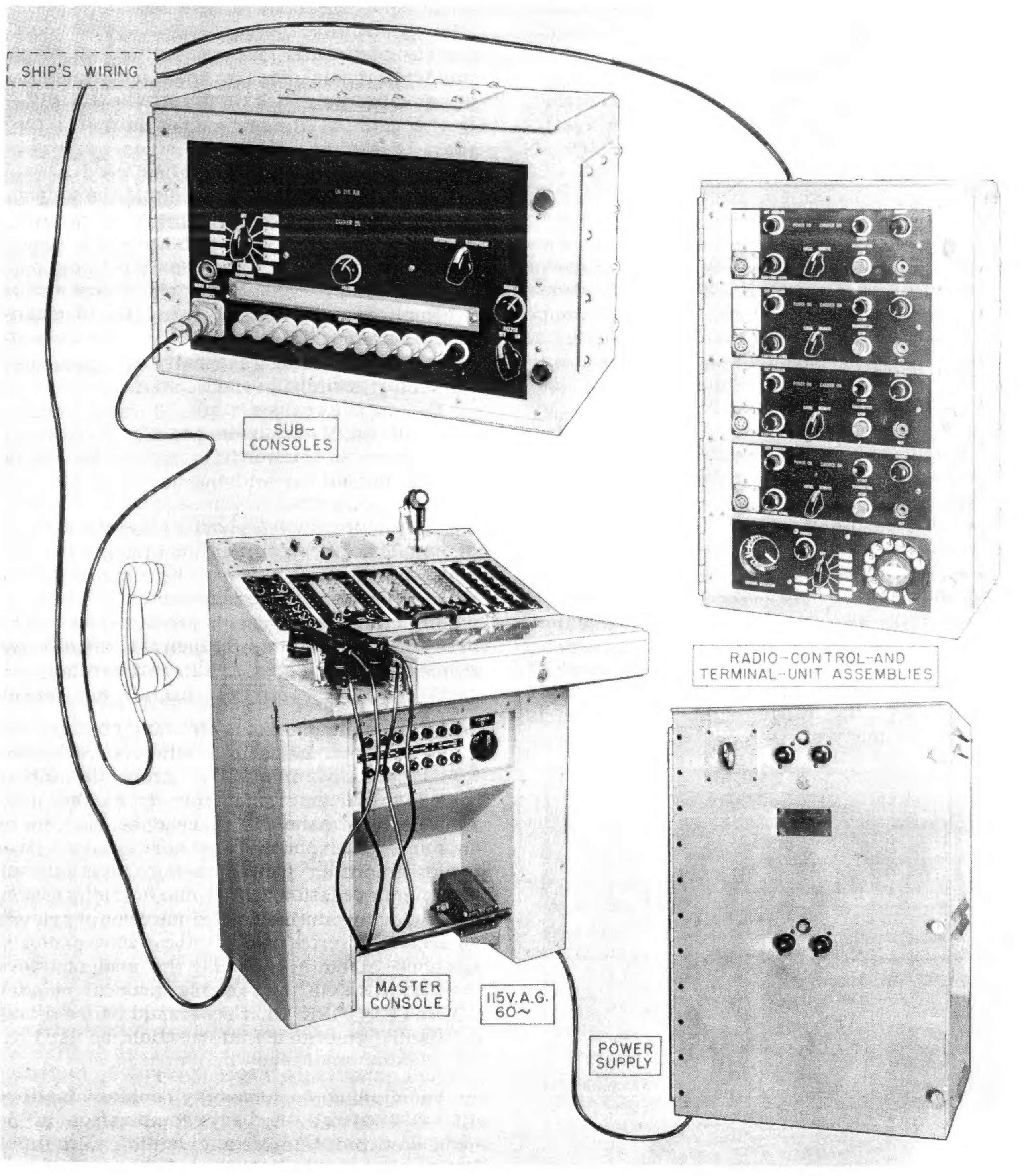

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Figure 12-4.—Communication Console AN/SIC-2.

shipboard announcing system when the communication console equipment is installed in CIC.

The subconsoles provide secondary control points for radiotelephone and interphone circuits. Each subconsole may select any 1 or 10 radio circuits for both transmitting and receiving. Two-way or network communications from the console to the master console and the other subconsoles take place over any 1 of 10 available interphone circuits. A radiotelephone jack is provided for monitoring the selected radiotelephone circuit or interphone circuit.

Normally, the master console is the CIC watch officer's station while the ship is underway. From this station, he can control as desired: radiotelephone, interphone, intercom, sound-powered telephone, and shipboard announcing circuits.

CARRIER CONTROL APPROACH (CCA) EQUIPMENT

Carrier controlled approach (CCA) equipment provides the means for guiding aircraft to safe landings under conditions approaching zero visibility. By means of radar, aircraft are detected and watched during the final approach and landing sequence. Guidance information is supplied to the pilot in the form of verbal radio instructions, or to the automatic pilot (autopilot) in the form of pulsed control signals.

Six CCA systems (or equipments) currently are installed aboard carriers in the active fleet. They are models AN/SPN-6, AN/SPN-10, AN/SPN-12, AN/SPN-35A, -35B, AN/SPN-42, AN/SPN-43.

The AN/SPN-6 CCA system displays an aircraft's position relative to an ideal approach path on offset sector PPIs. These presentations are viewed by an aircraft final controller, who transmits verbal landing instructions to the pilot. The aircraft is directed along an ideal approach path to a point where it is visible to the landing signal officer (LSO). When the aircraft is visible, the LSO operates a "contact" light that informs the controller that contact has been made and that the aircraft is being brought aboard by visual means. If the aircraft approaches to the minimum range of 200 feet from touchdown without the LSO indicating that he made contact, it is given an instrument waveoff by the final controller at the radar set.

The AN/SPN-10 is a computerized CCA system that provides precise control of aircraft during their final approach and landing. The equipment automatically acquires, controls, and lands a suitably equipped aircraft on CVA type aircraft carriers under severe ship motion, or weather conditions.

Aircraft returning to the carrier are assigned to the AN/SPN-10 system by means of an air traffic control computer. On receipt of an assignment, the system programs an optimum flight path for the aircraft. It also establishes a radar acquisition window (search area). When the assigned aircraft enters the window, it is automatically detected, locked onto, and tracked by the precision radar subsystem. The radar-derived data of the aircraft's position (flight path) are compared with the optimum flight path. As a result of this comparison, correction signals are generated to control the aircraft along the optimum flight path to touchdown.

If an unsafe flight or landing condition is indicated, the AN/SPN-10 signals a waveoff and returns control of the aircraft to the air traffic control computer. In addition, the LSO or equipment operator may initiate a waveoff sequence when, in his judgment, a safe landing cannot be accomplished. The pilot can terminate the automatic landing anytime at his discretion.

The AN/SPN-10 has two identical control channels. These channels, operating independently, provide an overall maximum system landing rate capability of one aircraft every 30 seconds, however one per minute is usually experienced. Each channel has three modes of operation: automatic, semiautomatic, and manual (voice talkdown). In all instances, the mode of operation is determined by the pilot of the landing aircraft, after which the operator will take the appropriate action to furnish the pilot with the desired control guidance.

The AN/SPN-12 is a range-rate radar set that computes, indicates, and records the speed of aircraft making a landing approach to the carrier. Both true air speed and relative speed are indicated. Thus, the LSO is supplied with accurate information on the speed of the approaching aircraft, and can wave off those attempting to land at an unsafe speed.

The AN/SPN-35, -35A is a lightweight carrier controlled approach radar designed to provide precision range azimuth, and elevation

information for aircraft during the final approach phase of flight onto aircraft carriers.

Aircraft normally enter AN/SPN-35, -35A control approximately ten miles from touchdown. Under optimum weather conditions, aircraft may enter AN/SPN-35, -35A control approximately twenty-five miles from touchdown. Information presented on the indicators provides the final approach controllers with precision information as to relative azimuth, range, and elevation of the aircraft. This enables the operator to direct the pilot along a predetermined glidepath and azimuth courseline. All aircraft on the glideslope and azimuth courseline are displayed and can be controlled.

The three major modes of operation for the AN/SPN-35, -35A are as follows:

(1) Normal Mode—For normal precision approach operation the azimuth antenna scans a 30 degree sector and the elevation antenna scans 11 degrees vertically.

(2) 35 Degree Elevation Mode—The azimuth antenna scans a 30 degree sector and the elevation antenna scans 35 degrees vertically.

(3) 60 Degree Azimuth Mode—The azimuth antenna scans a 60 degree sector and the elevation antenna scans 11 degrees vertically.

The AN/SPN-35A differs from the AN/SPN-35 in that the AN/SPN-35A employs a more reliable stabilization system to compensate for pitch and roll of the carrier in order to maintain precision azimuth and elevation coverage. The AN/SPN-35A employs an electromechanical stabilization system, whereas the AN/SPN-35 utilizes the modified mechanical-hydraulic stabilization system of the AN/SPN-6 radar.

The AN/SPN-42 is a landing control central which provides an automatic landing capability for aircraft under all-weather conditions. Aircraft enter the system through an acquisition "window" approximately four miles from the carrier. From this point to touchdown the operation is completely automatic, the pilot serving only as monitor. When the aircraft enter this window, the precision radar of the AN/SPN-42 tracks the aircraft and feeds position information to the computer group via the buffer group. The stabilization group feeds ship's motion data to the computer group in a similar manner. Operating on the stabilized aircraft position data, the computer group generates control signals for holding the aircraft on a predetermined flight path. Deck motion compensation is derived by the computer group from ship's motion data and is used to modify control of the aircraft during the last twelve seconds of flight. Control signals and wave-off command are transmitted to the aircraft by way of the NTDS data link and are implemented by the autopilot and appropriate cockpit indicators. Video presentation is provided to the AN/SPN-42 console operator on a conventional GCA type radar scope.

The AN/SPN-42 has three modes of operation: automatic, semiautomatic, and manual.

(1) Automatic (Mode I): In this mode, the aircraft is acquired and controlled from the acquisition "window" to touchdown without assistance from the operator or pilot, after the pilot signals that he is ready for control. Both the Landing Signal Officer and controlling operator monitor the landing sequence and may initiate a waveoff whenever an unsafe flight or landing condition exists. The pilot may also terminate the automatic landing at his discretion.

(2) Semiautomatic (Mode II): In this mode, the control signals are generated and transmitted via data link to cross-pointers for guidance to the pilot who has complete control of the aircraft.

(3) Manual (Mode III): In this mode, the operation is similar to GCA talkdown; no data link is required, only voice communications.

The AN/SPN-42 is an improvement over the present AN/SPN-10 Landing Control Central in that it offers far greater reliability and maintainability. The AN/SPN-42 employs digital computers and solid state circuitry, resulting in a Mean Time Between Failure of approximately 250 hours in Mode I; whereas the AN/SPN-10 has a Mean Time Between Failure of 35 hours in Mode I.

The AN/SPN-43 provides azimuth and range information from a minimum range of 250 yards to a maximum range of fifty miles at altitudes from horizon to 30,000 feet. The ship's radar indicators display the information to the operators in the Carrier Air Traffic Control Center. This enables the operator to direct the aircraft along a predetermined azimuth courseline to a point approximately one quarter mile from touchdown. At night or during adverse flying weather however, control of the aircraft is transferred to the precision approach radar (AN/SPN-35) or Landing Control Central (AN/SPN-42) for guidance along the glidepath and azimuth courseline to the carrier landing ramp.

The AN/SPN-43 modifies and improves the AN/SPN-6 radar air space coverage required for carrier landing operations.

The present AN/SPN-6 radar's vertical beam width of 2 1/2 degrees is inadequate to simultaneously cover normal carrier approach and bolter/waveoff patterns. Furthermore, the AN/SPN-6 no longer provides adequate range coverage for surveillance of aircraft at high altitudes.

TARGET CONTROL SYSTEM

The AN/SRW-4( ) target control system is installed principally aboard destroyers equipped with the Drone AntiSubmarine Helicopter (DASH). The system provides positive control of the drone during all phases of flight, including takeoff and landing, by transmitting to the helicopter commands in the form of coded FM radio signals.

The system consists of duplicate transmitters, coders, antennas, and operating control positions. Selection and operation of the transmitting arrangement are accomplished by the flight controllers at the operating position. Normally, one operating position is installed in the CIC; the other position is located in the vicinity of the flight deck. By manipulating the controls at the operating control positions, the controllers send altitude, bearing, speed, and various special command signals to the drone. In the drone, the signals are accepted by a receiver and processed and applied to an Automatic Flight Control Set (AFCS). The AFCS causes the drone to execute the command signals.

The drone is started and preflighted from the deck controller's position. On signal from the CIC controller, the deck controller launches the drone and vectors it toward the target or to a holding position. He then relays to the CIC controller the altitude, speed, and heading of the drone as indicated at his control position. The controller in CIC sets these data into his operating position, and takes control of the drone when it appears on the CIC radar display. He pilots the drone throughout its mission and return to the ship. When the drone comes into view, control is transferred back to the deck controller, who executes the approach and landing.

INFRARED EQUIPMENT

Infrared equipment belongs to a family of devices which use electro-optics for communication, surveillance, detection, and navigation. Also included are image intensifying night observation devices, low level television, and lasers.

Infrared equipment is designed to create, control, or detect invisible infrared radiations. The equipment is of two types transmitting and receiving. The transmitting (source) equipment produces and directs the radiations. The receiving equipment detects and converts the radiations into either visible light for viewing purposes, or into voice or code signals for audible presentation.

Infrared devices can be used for weapon guidance, detection of enemy equipment and personnel, navigation, recognition, aircraft proximity warning, and communications. Depending on its application, the equipment is either passive or active. The active method employs both transmitting and receiving equipment, whereas the passive method requires only receiving equipment.

The infrared spectrum, which extends from the upper limits of the radio microwave region to the visible light region in the electromagnetic spectrum (fig. 12-5), is divided into three bands: near infrared, intermediate or middle infrared, and far infrared. Devices operating in the near and middle bands are used for ranging, recognition, and communications. They normally have a usable distance range of 6.5 to 10 miles. Equipment that operates in the far infrared band is used for ranging, missile guidance, and the detection and location of personnel, tanks, ships, aircraft, and the like. This equipment is usually effective at distances between 100 yards and 12 miles.

Some of the infrared devices in use in the fleet today are the blinker equipments AN/SAT-( ), and VS-18( )/SAT; the voice/tone equipments AN/SAC-4, AN/PAC-3, and AN/PAR-1; and the viewer AN/SAR-( ) equipments. A brief description of the equipment follows.

Perhaps the most widely used infrared transmitting gear is the VS-18( )/SAT hood, with filter lens. It is mounted on the standard Navy 12-inch searchlight (fig. 12-6). It blocks most of the visible light so the searchlight cannot be seen at a distance. The light is operated in the same manner as an ordinary communication searchlight. Using the same

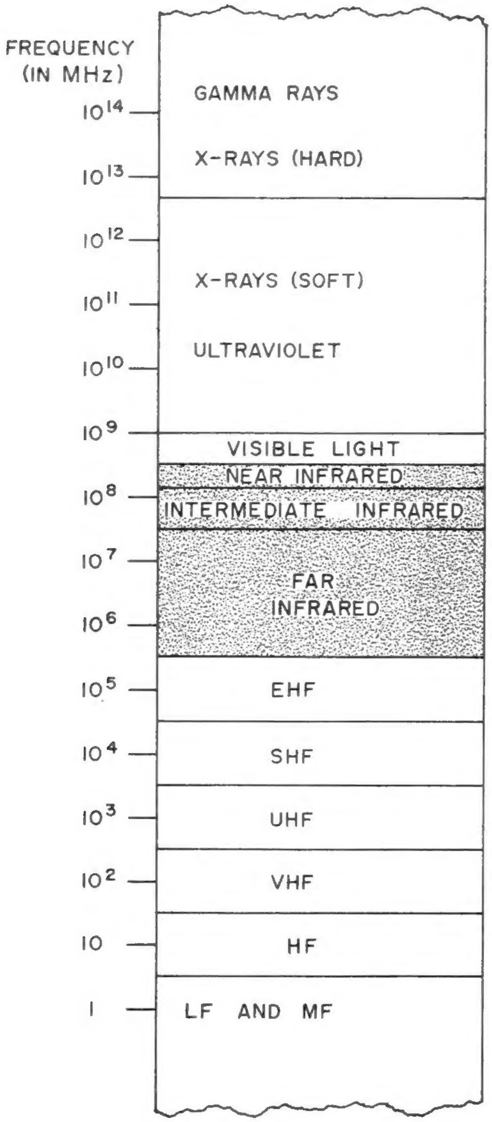

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Figure 12-5.—Electromagnetic spectrum showing infrared bands.

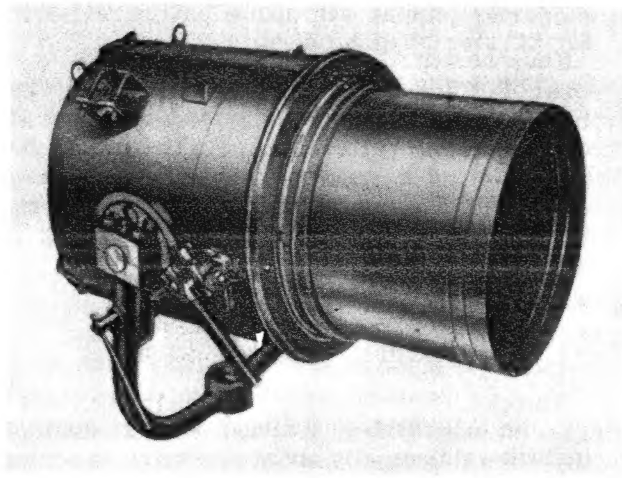

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Figure 12-6.—The VS-18( )/SAT infrared hood on 12-inch searchlight.

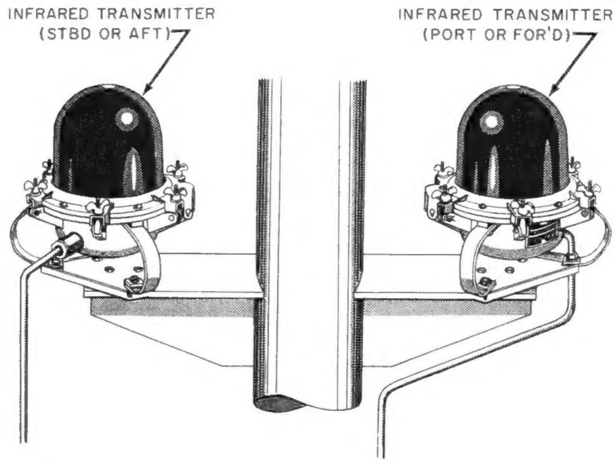

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Figure 12-7.—Infrared Yardarm Beacons AN/SAT-( ).

design, there are variations to the VS-18( )/SAT hood for use on nonmagnetic minesweepers, the 8-inch signal light, and hand signal lamps.

Another type of infrared transmitting equipment is a 360° light, which is installed in pairs on yardarms (fig. 12-7) of the majority of naval ships. These lights, designated AN/SAT-( ), are operated in the same manner as yardarm blinkers. They can be used as a steady source for "point of train" (POT) purposes, or they can be used for signaling or recognition purposes.

A third important transmitter is the X-9B small craft beacon. It is similar to the AN/SAT-2 but is smaller and powered by 24 volts from the small craft electrical system.

The voice-tone equipments are not in general use. They work by modulation of

a light beam which is received and amplified by a photocell receiver.

Electronic infrared viewers convert the infrared rays to visible light. They must be used to detect signals from the VS-18( )/SAT or AN/SAT-( ), or to observe a night scene illuminated by an infrared searchlight.

The AN/SAR-4( ) viewing set (fig. 12-8) is a very old set still used in the fleet. It consists of two main units; (1) a 115 volts AC converted to a 20,000 volts DC power supply, and (2) the viewer unit which consists of a sealed housing and two interchangeable sets of lenses. The housing contains an image converter tube which produces an image of the infrared scene on a phosphorescent screen. The AN/SAR-6 viewing set (fig. 12-9) is similar to the AN/SAR-4( ) except that it has an internal battery power supply instead of a separate power unit. The AN/SAR-7( ) viewing set (not shown) is similar to the AN/SAR-6 but is smaller and lighter. The Type T-7 (AN/PAS-6) infrared metascope (not shown) is a small pocket-sized viewer used chiefly in amphibious operations. It includes an infrared flashlight which can be used for signaling, chart reading, and the like.

METEOROLOGICAL EQUIPMENT

Electronic meteorological equipments consist of a variety of equipments, each serving different purposes. Electronic devices have been developed to measure cloud heights and visibility. Others measure winds aloft, as well as temperature, pressure, and humidity in the upper air. Still others were developed as complete weather stations that report automatically by radio. By far the most sophisticated of the recent developments of electronic

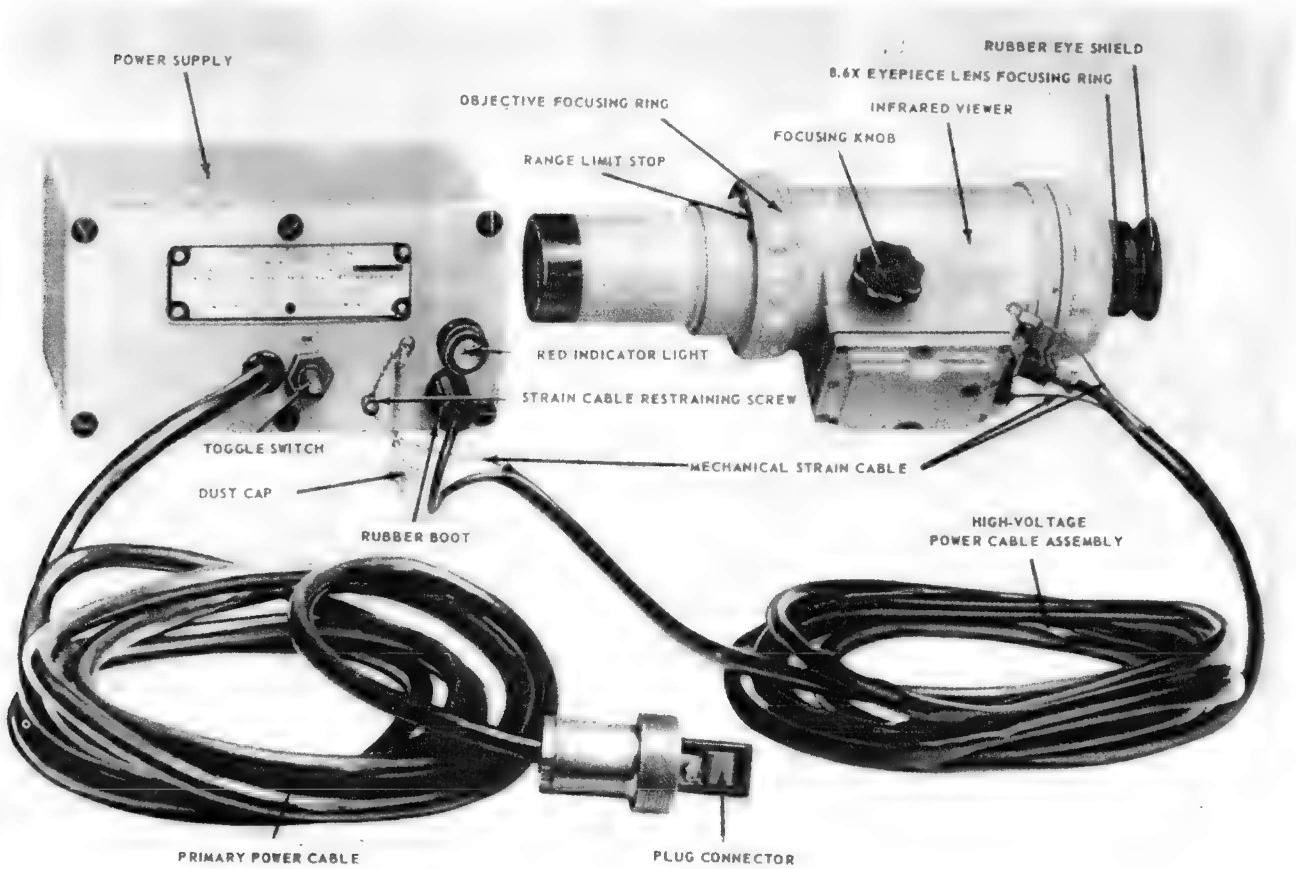

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Figure 12-8.—Electronic Infrared Receiver AN/SAR-4( ).

Figure 12-9.—Electronic Infrared Receiver AN/SAR-6.

meteorological devices are the weather satellites.

Two meteorological devices that are representative of the types carried aboard naval vessels are the AN/AMT-11( ) radiosonde and the AN/SMQ-1( ) radiosonde receiving set. (Radiosondes are the flight equipment used in making upper air pressure, temperature, humidity, and, in some instances, wind observations. Depending on the type they are carried aloft by ballons or are dropped from aircraft.)

The AN/AMT-11( ) radiosonde (fig. 12-10) is an expendable scientific instrument designed to be carried aloft by a sounding balloon. During its flight, the radiosonde transmits pulse-modulated radio signals in the frequency range 395 to 406 MHz. When properly recorded and interpreted, these signals give a continuous reading of the pressure, temperature, and humidity of the atmosphere through which the instrument passes. Wind direction and velocity are measured by tracking the radiosonde with radar or radio direction finders.

Radiosonde receptor AN/SMQ-1( ) (fig. 12-11) receives, amplifies, demodulates, and graphically records the signals transmitted by the AN/AMT-11( ). The received signals are pulses of RF energy. The frequency of repetition of these pulses depends on meteorological conditions. Each pulse is approximately 250 to 275 μsec in duration, and the pulse repetition rate varies from 10 to 200 PPS. Usually, the received signal is a series of pulses at one audio rate followed by a series of pulses at a different audio rate. Each series of pulses causes the receptor to record on a chart in a certain position, as determined by the audio rate of that particular series of pulses. The order in which these different series are recorded is known and common to all radiosondes of a particular type. Thus, it is possible to interpret and evaluate the chart.

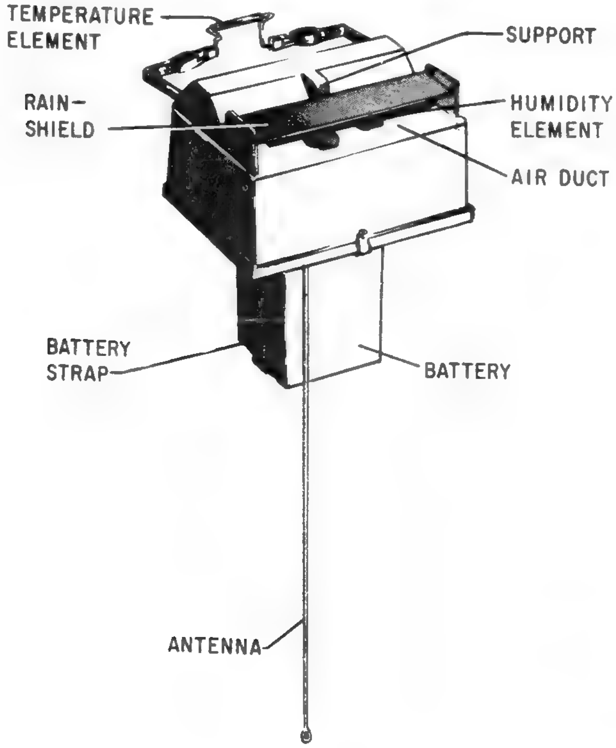

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Figure 12-10.—Radiosonde AN/AMT-11( ).

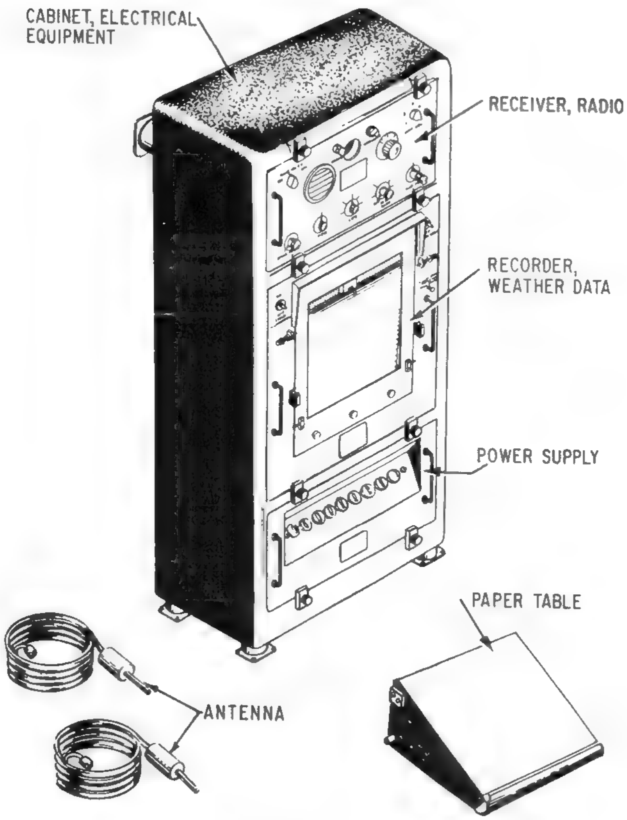

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Figure 12-11.—Radiosonde Receptor AN/SMQ-1( ).

RADIAC EQUIPMENT

An important factor in the control of danger to personnel from nuclear radiation is the determination of how much radiation has been absorbed by personnel and how much is present on the ship. Because it is impossible to see, feel, or smell radiation, special instruments have been developed to detect and measure radiation. These radiological measuring instruments are known as radiac devices. (Radiac is a short term derived from the underlined letters of the words radioactivity detection, indication, and computation.) Radiac instruments are designed to (1) detect and measure alpha, beta, gamma, and neutron radiation, (2) measure the intensity of radiation, (3) determine the extent of contamination, (4) provide information for calculating the length of time that contamination will exist in an area, and (5) protect personnel by providing means for determining the radiation dose received.

Radiac instruments are of two general types: (1) those that show how much radiation has been received over a period of time (accumulated dose); and (2) those that indicate the amount of radiation at any particular instant (dose rate). Instruments of the first type, usually called dosimeters, are used to measure the amount of radiation to which a person has been exposed during a given period of time. Equipment of the second type are radiacmeters, and are used chiefly for surveying contaminated areas, structures, or objects to determine the amount and type of radiation emitted.

Dose rate or intensity is expressed as either "roentgen per hour" or "rads per hour." The roentgen is the unit of exposure to radioactive doses of gamma and X-rays. The roentgen is being replaced by rad as the standard unit of absorbed radioactive dose. Because absorbed dose is the most critical of the two, most new detection devices are scaled to read in rads. An added factor in using rads is that the term expresses the dose from any

type of radiation, whereas roentgen relates only to gamma radiation or X-rays. Due to the large number of detection devices still in use that are scaled in roentgens, roentgen is used in this text.

DOSIMETER

A typical pocket dosimeter of the self-reading type is the IM-9( )/PD. This instrument and its charging unit PP-354( )/PD are shown in figure 12-12. At one end of the dosimeter is an optical eyepiece; at the other end, a charging contact. When the dosimeter is fully charged, an indicator viewed through the eyepiece is at the zero point on a scale. As radiation penetrates the instrument, its charge is dissipated or neutralized, and the indicator moves along the scale a distance proportional to the quantity of radiation received.

By holding the dosimeter to the light and peering through the eyepiece, the total radiation dose received in milliroentgens can be read directly from the scale. The instrument measures (up to 200 milliroentgens) the X- or gamma radiation accumulated by an individual. It is used by personnel who work in contaminated areas to indicate when the accumulated maximum permissible exposure is reached.

Although a self-reading dosimeter, it requires a separate charging and adjusting device

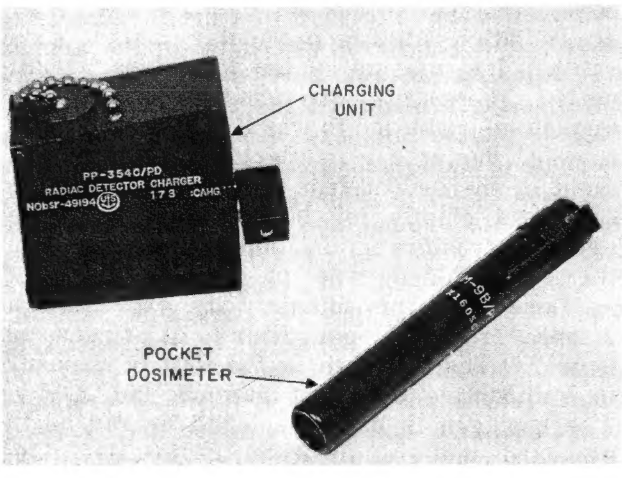

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Figure 12-12.—Pocket Dosimeter IM-9( )/PD, with chargtng unit PP-354( )/PD.

for setting the movable element on the zero of the interior scale. The charger (fig. 12-12) requires no external power source; it produces a static electrical charge when the knob on the front of the unit is rotated. This pocket-sized device, known as the PD-354( )/PD charger, can serve many types of dosimeters.

The high-range nonself-reading dosimeter, DT-60/PD (not shown) is for use by all ship's personnel. This dosimeter consists of a special phosphate glass housed in a moistureproof plastic case. The dosimeter is about the size of a pocket watch, weights less than an ounce, and is of sturdy construction. It will measure accumulated dose from 10 to 600 roentgens. A special instrument, CP-95/PD, is required to read it. The dose indication does not change with time (after use); therefore, the dosimeter may be reused and read repeatedly.

RATEMETER

Ratemeters used for measuring radiation intensity (dose rate) contain electronic circuits that detect the presence of radiation and indicate its intensity on a direct-reading meter. These radiac instruments are available in various sizes; some are portable, others are fixed. The ratemeters use different detection methods to measure alpha, beta, gamma, and neutron radiation. Among the various types are the AN/PDR-18, -27, -43, -45, -56, -65, -70 and the AN/SDR-1, -2. A description of some of these ratemeters follows.

The Radiac Set AN/PDR-27 (fig. 12-13) is a portable, watertight, battery-operated instrument that furnishes visual and aural indication of the detection and/or measurement of gamma and beta radiation. It has a range of 0 to 500 milliroentgens per hour (MR/HR) and is used to detect low intensity beta radiation or low intensities of beta and gamma radiations together, or detect and measure gamma radiations alone. It is used to detect low intensities of beta and/or gamma radiation, such as might be found on clothing or hands of personnel, or in moderately contaminated radioactive areas. In general, it is used for detailed monitoring of personnel, spaces, and material.

The high-range intensity meter, AN/PDR-43( ), is a "pulsed" (controlled on time) end-window Geiger-Mueller (G.M.) type, portable radiac for measuring gamma radiation and detecting beta radiation (fig. 12-14). The end-window G.M. tube and associated electronic

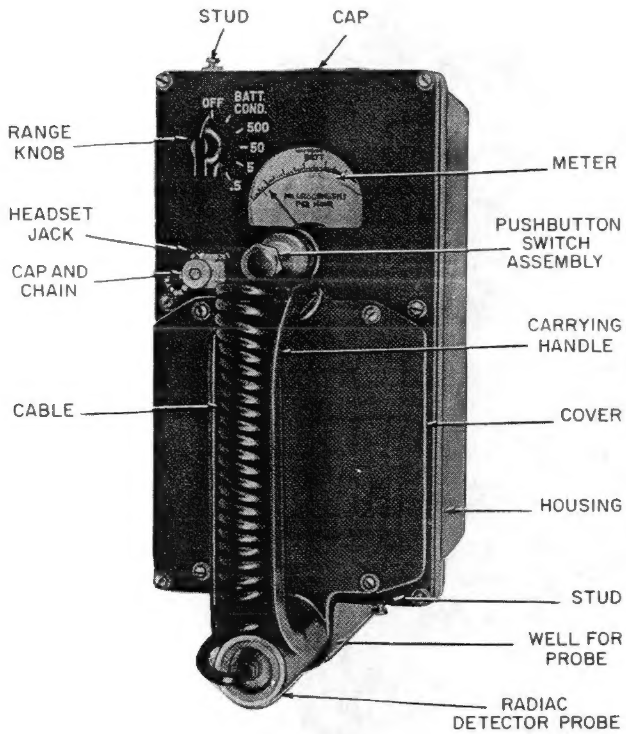

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Figure 12-13.—Radiac Set AN/PDR-27( ).

circuits are contained in a single metal case. X-ray and gamma radiation penetrates material more readily than does beta; therefore an "end window" of relatively smaller thickness compared to the remainder of the cylinder wall is used to permit beta penetrations. The gamma-intensity range scales are 0 to 5, 0 to 50, and 0 to 500 roentgens per hour. Beta-gamma radiation may be detected on these range scales by properly positioning the function selector slide (beta shield-source slide) located on the bottom of the case. A 50-microcurie source is contained on the function selector slide to check the range scales for response to radiation. The numerals on the meter face change with the position of the range selector switch. The following controls are provided; (1) a range selector switch with positions for OFF, BATT, and the three range scales; and (2) a function selector slide with OPERATION CHECK, GAMMA, and BETA positions. In the OPERATION CHECK position, the end-window of the G.M. tube is exposed to the 50 microcurie source. In the GAMMA position, only gamma radiation is detected by the G.M. tube. In the BETA position, the end-window of the G.M. tube is exposed to beta and gamma radiations.

The AN/PDR-56 (fig. 12-15) is the Navy's standard alpha survey meter. This radiac set is hand carried and is comprised of a ratemeter with an auxiliary probe, a shoulder harness, a headset, a probe handle extension, and a carrying case (fig. 12-15. The ratemeter receives pulses from the probe and converts them in a discriminator and ratemeter ciruit to a meter reading. The reading is proportional to the amount of alpha contamination as seen by the probe. The AN/PDR-56( ) detects and measures the intensity of alpha radiation in counts per minute.

The AN/PDR-65 (fig. 12-16) is a high-intensity instrument that provides gamma radiation dose and dose rate information needed for tactical decisions. It is designed primarily for fixed shipboard installation but can be used as a portable instrument. It measures gamma field intensity to 10,000 rads/hr and dose to 10,000 rads. The rate meter portion of the instrument has four sensitivity ranges: 0 - 10, 0 - 100, 0 - 1000, and 0 - 10,000. Accumulated dose is given numerically in increments of 1 rad. The radiacmeter consists principally of a detector assembly, power supply and remote control unit, remote detector mounting bracket, 200 feet of remote detector cable, and a carrying case.

The AN/PDR-65 utilizes a recycling ionization chamber detection principle with a recycling event occurring every 0.5 millirad. (A recycling ionization chamber charges and discharges like a capacitor.) A sounder with a low-range capability gives an aural indication of each recycling event. The detector assembly can operate remotely up to 500 feet from the instrument housing. Two units may be interconnected, e.g., one at a topside station and one belowdeck, so that the dose rate topside can be monitored at the readout unit belowdeck.

The AN/PDR-65 is designed for continuous operation from a 115-volt, 60-hertz circuit. For the portable mode of operation it is provided with four rechargeable nickel cadmiun C batteries.

The AN/SDR-1 and -2 are older fixed radiac systems aboard ships. They indicate field intensity of gamma radiation up to 10,000 roentgens per hour. These sets have audible alarms that ring at a rate proportional to the field intensity. The alarm may be set

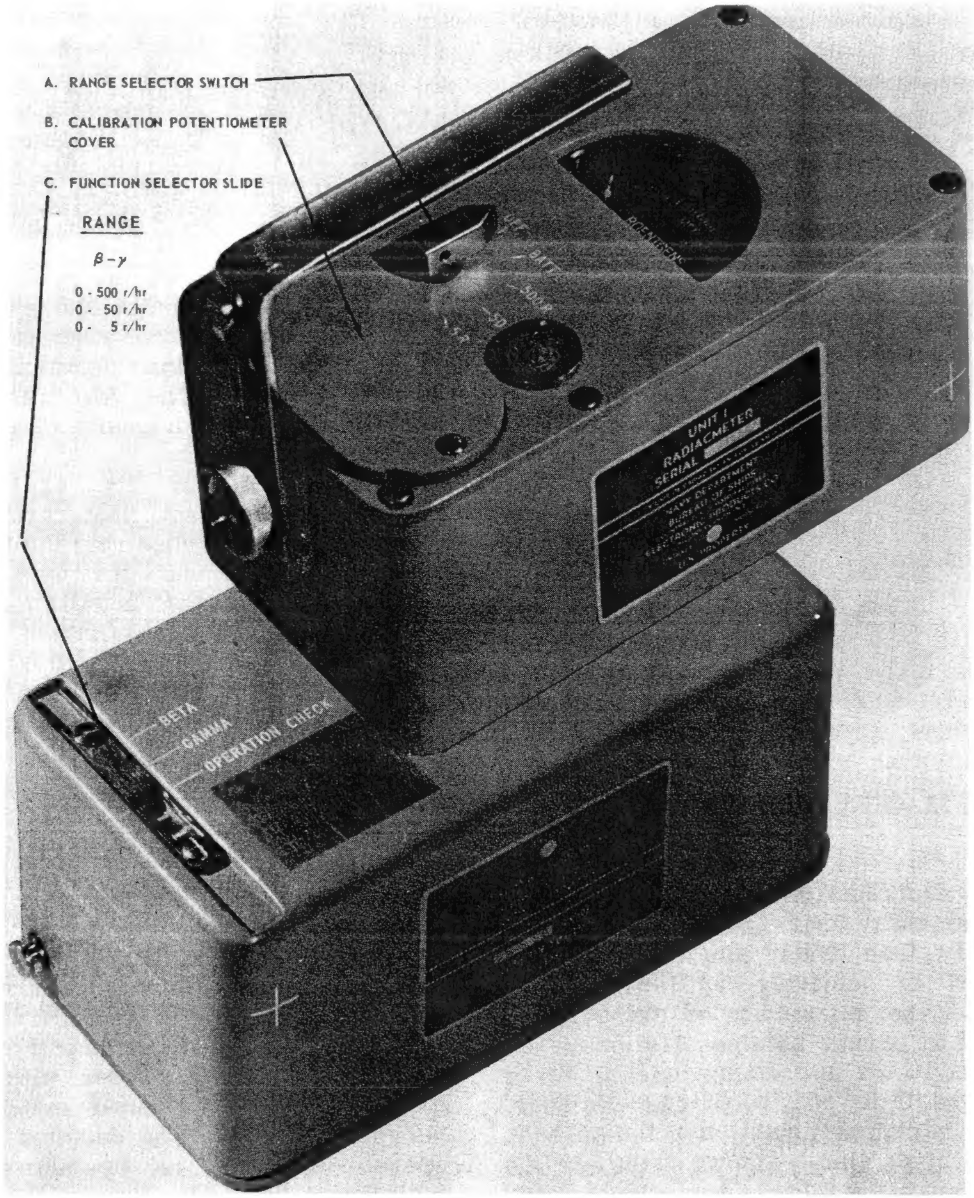

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Figure 12-14.—Radiacmeter AN/PDR-43( ).

to operate when the radiation field exceeds a preset level of intensity between 0 to 1000 milliroentgens per hour.

The systems include remote radiac indicators and a training device. The training device can simulate high-range readings for the remote indicators during field defense training exercises. The radiacmeter is designed for continuous operation from a 115-volt AC power source. It, in turn, supplies the power to all other units. If the normal power source fails, a built-in battery operates the equipment for a maximum of 50 hours. When the AC power is returned, the discharged battery commences recharging and assumes a full charge within 24 hours.

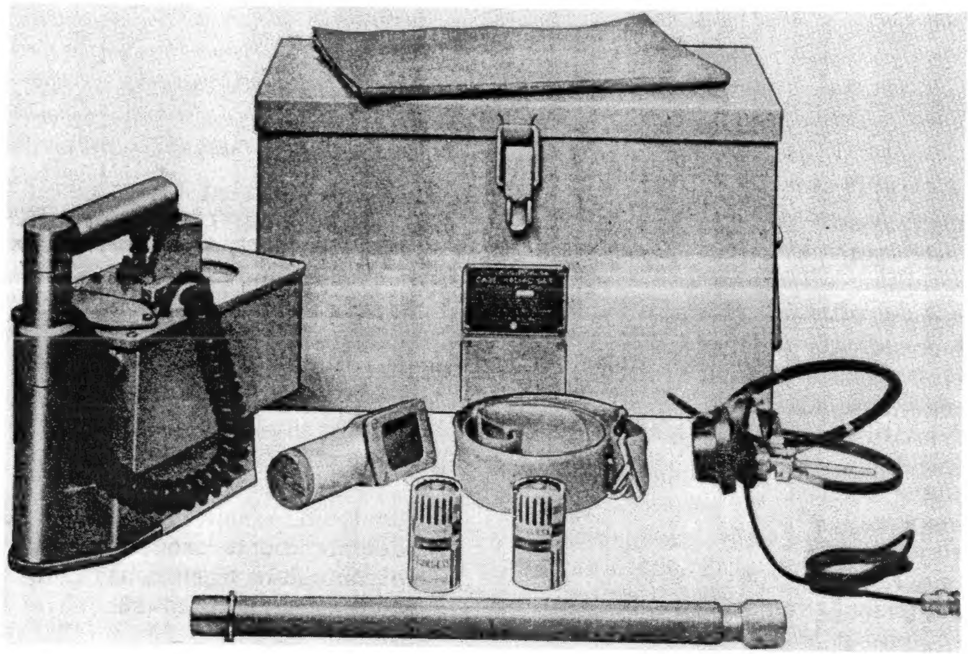

Figure 12-15.—Radiac Set AN/PDR-56. 5.184

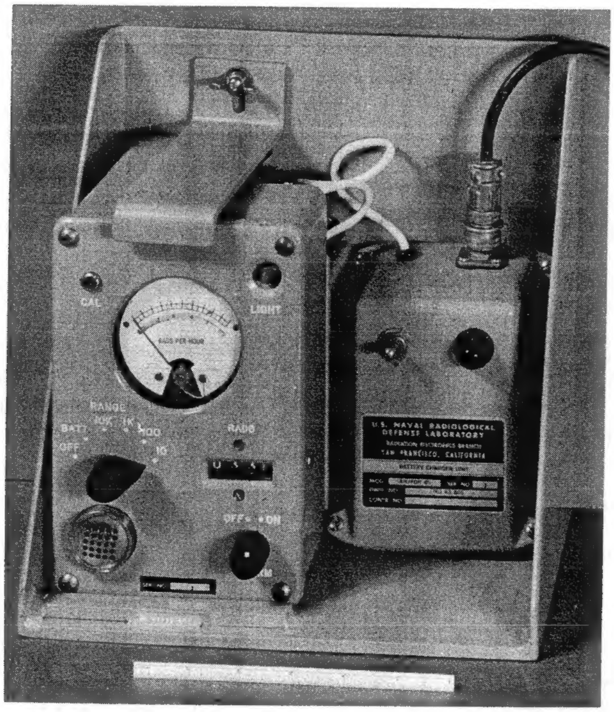

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Figure 12-16.—Radiac Set AN/PDR-65.